10. WATER EFFICIENCY PLANS

10.1 Overview

The recommended water efficiency plans for the five pilot communities are comprised of measures outlined and assessed in the previous sections. In this instance the plans include a selection of measures from the DSS assessment as well as discussion of other issues including pricing, regulations and non-residential approaches. This section describes how the plans were developed and describes the elements that comprise the plans.

10.1.1 Selection of Measures for Inclusion in Water Efficiency Plans

Measures included in the recommended plans are selected following a review of the benefit/cost analysis results. From these results, a combination of measures is selected and assessed to ascertain the potential benefits and savings that could be realised using a particular combination. Measures are usually screened primarily on factors relating to their technical feasibility and applicability to the community. The benefit/cost analysis takes into account the water savings and implementation costs, and gives a comparative result for all measures. Typically, measures with a benefit/cost ratio greater than one (1.0) are considered for Water Efficiency Plans. Depending on the number of measures being assessed, and the range of B/C's achieved, the qualifying B/C ratio may be revised to reduce or increase the number of qualifying measures be included in a Water Efficiency Plan.

One of the major determinants in selecting engineering projects is the environmental impact. In the case of demand management projects, the impacts on the environment are, with few exceptions, positive. Where water is saved it generally remains in streams and reservoirs for other beneficial uses such as for ecology enhancement, recreation and power generation.

Some measures save hot water and therefore energy, which can benefit the community where the energy is generated. Energy savings are computed in the evaluation process and considered in the measure selection process through the community benefits. Such savings are used in assessing the participation rate of a proposed program. The cost effectiveness of the measure can also positively enhance the community's well being. If a measure is cost effective then the community has more money to spend on other goods and services. So there are benefits and costs beyond those quantified and included in the benefit/cost analysis.

As stated previously in this report, the savings by the individual customer relating to lower water bills are not considered. Where a large scale Water Efficiency Program is successfully implemented, the price of water will probably increase in terms of $/kL. This is due to the high proportion of non-volume related costs which are included in the price of water e.g. salaries, depreciation, rate of return etc. Without detailed assessment

of water price paths over the period of the analysis it is not possible to accurately determine the savings per account relating to reduction in water bills.

The following criteria may be used to combine measures into a water efficiency plan:

- Benefit/cost ratio greater than 1.0
- Reasonable (i.e. affordable) cost
- Significant water savings
- Impacts on Council budgets and staffing
- Non-quantifiable impacts to the community such as reduction of greenhouse gases.

A description of the criteria is given below:

- *Benefit/Cost Ratio*

  The benefit/cost ratio is essentially a screening device. Small differences between measure benefit/cost ratios should be ignored, due to the numerous assumptions that must be made to complete the analysis. For example, a difference of 1.5 to 1.75 is not viewed as significant, whereas a difference of 1.5 to 3.0 is significant.

  The perspective used to compute the program is mainly that of the authority, (utility or council). It is the authority that must provide direction and funding for water efficiency. The authority will be recipients of savings from capital deferrals, and operations and maintenance cost reductions resulting from a program. Savings will be passed on to customers. An alternative perspective is that of the community. Members of the community may be called upon to install a device or implement a measure at their own expense. Their relative payback is used in estimating the water savings from the measure. Customers generally want a payback of less than three years. Measures with longer paybacks are difficult to implement and the resultant low acceptance rate is accounted for in the B/C analysis.

- *Reasonable Cost*

  Measures may have the same present value of costs but one may require large initial funding, whereas the other requires small annual payments over the long-term. The latter measure could be more affordable and compatible with the council budgeting process. For example, say two measures may have the same present value of costs. One may consist of audits done by staff over time (costing say $50,000 per year for ten years). The other measure may involve a short duration rebate program (say $300,000 spread over three years). The latter program may be less affordable because of the large injection of funds required over a short duration.

- *Impacts on Council Budgeting and Staffing*

  The authority will be limited in the number of programs that can be administered at one time. A normal workload is the order of 5 to 10 different measures. To simplify the administration and administrative costs, a few

larger programs would be preferred over a number of smaller ones with the same total water savings. Also a program may be selected for the plan if the water savings are very attractive but the benefit/cost ratio is slightly below 1.0. The costs of the plans includes the cost of existing and/or new staff. Some authorities may prefer to hire staff and do the program in-house, whereas others may have difficulty hiring new staff or may prefer to do most of the fieldwork by contract.

- *Significant Water Savings*

  Water savings calculated for a measure will assist to distinguish which measures are most attractive for selection in a water efficiency plan. If a measure is shown to exhibit a high benefit/cost and provides significant water savings (ie. Ó 0.5 ML/d for Maroochy), then it is most likely to be considered. If a measure exhibits a high benefit/cost, but low water saving (ie. Ò 0.1 ML/d for Maroochy), it may be excluded from a water efficiency plan. Rejection of such measures will occur, particularly when the number of measures needs to be minimised, to ensure that the resulting program is manageable for the authority. Significant water savings from a measure may also make a marginal benefit / cost (ie. 0.85 to 1.0) measure applicable for selection.

- *Non-Quantifiable Impacts on the Community*

  Non-quantifiable benefits relate mainly to the environment and include the ecology of rivers and greenhouse emissions. One of the major non-quantifiable impacts to be taken into account is the reduction in CO_2 or greenhouse emissions. Water conservation will achieve energy savings that will result in less fossil fuel being burned at the power stations and will result in less air pollution and greenhouse impacts. If water is saved, it remains in streams and reservoirs for other beneficial uses such as for the enhancement of the ecology or for recreation.

The criteria adopted for this study are primarily:

- Benefit/Cost Ratio
- Reasonable Cost
- Significant Water Savings

Each of these criteria relate to the benefit / cost and water savings of a group of measures. The non-quantifiable environmental criteria were not considered in detail, except from the perspective of practically implementing the measure.

10.1.2 Definition of Community Water Efficiency Plans

After analysing the measures in each of the pilot communities, a localised Water Efficiency Plan was formulated. A range of water efficiency plans are usually developed taking into account the interaction of selected measures with each other. This is an important step as the savings from any program are not simply the total of the savings from individual measures. The attenuating effect caused by the interaction of multiple measures needs to be considered.

To undertake this analysis a measure Impact Factor is determined based on the ratio of the modified end use to the original end use for the measure. The measure Impact Factors are multiplied by the savings for each measure in a program to determine the program water savings. For this study the selection of measures for the plans was undertaken as follows:

Program A — *Passive Program* involving a small number of measures requiring the minimum implementation effort by the authority.

Program B — *Active Program* involving a combination of measures which best fit the selection criteria and requiring an active community based implementation approach.

The Water Efficiency Plans for each of the pilot communities are presented in Section 10.2. A definition of the important terms used in the discussion of the Water Efficiency Plans is as follows:

- *Original Baseline*

  A baseline refers to the projection of demands over a 30-year period from the original start year. The *original baseline* is a demand projection based on existing per capita demand, which is multiplied by the projected population in an area for any given year. The per capita demand is determined through the demand analysis presented in Section 4. This baseline excludes the effects of *natural conservation*.

- *Natural Conservation*

  Aside from focussed efforts to achieve water efficiency, water conservation will also occur as a result of developing technology and higher performance standards for water fixtures. Existing devices or appliances such as showers, taps or toilets will be superseded or replaced in future by more water efficient designs. This will produce a reduction in the original baseline forecast, as the original baseline is based on maintaining the status quo, and does not take into account the effects of the water efficient devices that may be available in the future. The water savings created by the replacement of existing devices with water efficient devices without the intervention of the authority is known as *natural conservation*.

- *Modified Baseline*

  The *modified baseline* is a demand projection taking into account the effects of natural conservation. The result will be a reduced projection compared to the *original baseline* calculations.

- *Annual Water Savings*

  By projecting demands using the modified baseline method and implementing a water conservation program, the *annual water savings* can be calculated. The annual water savings are defined as the reduction in water usage from the original baseline to the highest impact water conservation program. To calculate the annual water savings, the total water usage at the end of the

analysis period (i.e. 2029) is subtracted from the modified baseline, and averaged over the 30 year assumed life of the analysis.

- *Total Potential Savings*

  The *total potential savings* are defined as the total water saved through both the water efficiency program and natural conservation.

- *Benefit/Cost Ratio*

  The benefit/cost (or B/C) ratio is determined by dividing the benefits of implementing a program by the costs of the program. Benefits of implementing a program may include:

  - Deferral of capital works projects
  - Downsizing of capital works projects
  - Reduction in the cost of treatment and transfer of water
  - Reduction in the cost of transferring and disposing of sewage or sewage effluent.
  - Reduction in energy costs to heat water

  Costs of implementing a Water Efficiency Plan include the measure design and management, promotion and the costs of rebates, giveaways and audits.

  Benefits and costs do not include environmental or social aspects of a Water Efficiency Plan, or for the offsetting of costs through developing co-sponsoring opportunities with organisations, such as the electricity supply companies.

  A B/C of 1.0 means that the costs of reducing demand equal the benefits gained, and therefore is referred to as the *breakeven point*.

  The B/C ratios determined for this report are considered from two separate perspectives – that of the authority (or utility) and that of the community as a whole.

- *Utility Benefit/Cost Ratio*

  To implement the measures discussed, the utility is usually required to provide a proportion of the required funds. Costs typically relate to staff or materials needed for the implementation of measures. High B/C ratios for the utility usually relate to a measure with only a small outlay and major benefits, such as the Irrigation Advisory Service.

- *Total Community Benefit/Cost Ratio*

  The community will incur cost for implementing a water efficiency measure. Such costs relate to the purchase of a new device or appliance that will contribute to water savings or to offset the costs experienced by the utility in activities such as audits.
  If a measure results in the reduction of hot water usage, such as those involving shower related conservation measures, there is a higher cost saving to the community than there would be to the utility. This is because the cost of heating each unit of water has been lowered, increasing the savings to the

community. The savings that are achieved through the reduction of hot water usage are expressed as *energy savings*.

10.1.3 Natural Conservation

Long term demand projections are typically carried out by adopting current water usage levels (i.e., per capita demand) and multiplying forecast populations. This can be an effective way to estimate future demand levels, but it does not take into account the effects of the propagation of water efficient technology. More recently designed water using fixtures and appliances will adopt water use levels below that of most existing fixtures and appliances, and overall, these newer technologies will cause a reduction of future demand projections. Existing fixtures or appliances will be superseded by those utilising advancements in water using technology, as well as new properties being fitted out with these new fixtures and appliances, creating a decline in demand level. This reduction in demand projection is known as natural conservation.

When creating a baseline against which water efficiency measures are to be assessed, it is therefore necessary to consider natural conservation. An accurate estimation of the benefit / cost of a Water Efficiency Plan relies on taking into account the natural conservation in the study area, and how it may impact on projected demand. Reduction of water use through natural conservation was taken into account for the following end uses:

- *Toilets*

  The replacement of existing toilets with 6/3 L flush toilets will occur in the future because of Australian Government regulations set in place in 1984. All new and retrofitted properties must use 6/3 L toilets.

- *Showerheads*

  Water efficient showerheads achieve a substantial reduction over older styles of showerhead's water use. With the availability of these fixtures becoming more widespread, it was assumed that this market share will increase.

- *Taps*

  Tap fixtures have become more water efficient with the integration of aerators or restrictors into their design.

- *Washing Machines*

  Washing machine designs are continuously implementing more water efficient technology through the improvements in electronic technology.

- *Urinals*

  Water efficient urinal design will be improved in the future, through the use of flush regulation devices. The use of electronics in the design of these devices will ensure that future water use is reduced.

Maintaining these assumptions, *fixture models* were developed in the Baseline Demand Forecast of the DSS, which were then included as a basis for all Water Efficiency Measure and Plan assessment carried out in this study.

A *fixture model* within the DSS has a dual purpose. Firstly, it forecasts the changes in water use based on changes in the market share of three varying levels of water efficiency. In doing so it takes into account the market share of fixtures chosen by new customers, and the natural replacement of older fixtures through renovation and retrofit at the end of a fixtures' life. The second purpose of the fixture model in the DSS is to calculate the costs and benefits of an active retrofit program, where existing fixtures are replaced either for free or at a subsidised cost. This purpose is not considered when first establishing the modified baseline, which defines the effects of natural conservation.

For the calculation of natural conservation, the following data was input to each fixture model in the DSS:

- *Appliance Data*

  This is the assumed level of market penetration that each of the three fixtures / appliances currently have in the community.

- *Replacement Appliance Market Shares*

  The proportion of the total market share that each of the three fixtures / appliances will achieve for those fixtures / appliances that are replaced.

- *New Appliance Market Shares*

  The proportion of market share that each of the three fixtures / appliances will achieve for all new purchases.

The assumptions for the fixture models used in the calculation of natural conservation in the DSS are detailed in the tables below.

Table 10.1: Summary of Appliance Market Share– 6/3 L Dual Flush Fixture Model

Type of Appliance / Fixture	Volume per Use (Litres)	Existing Market Share
6/3 L Dual Flush	4.5	10.0%
9/4½ L Dual Flush	6.8	5.0%
11L High Flush	11.0	85.0%

The two tables featured below (Tables 10.2 and 10.3) assume the same proportion of take-up as each other. (Take-up is the percentage of the market that participates in a particular purchase.) The replacement of an existing fixture or the purchases of a new fixture account for a certain proportion of the overall market. When the take-up rates (as listed in Tables 10.2 and 10.3) are applied to the proportion of the market that is taken up by the sector, the result will be different proportions of overall market take-up.

Table 10.2: Summary of Replacement Appliance Market Share – 6/3 L Dual Flush Fixture Model

Year	6/3 L Dual Flush	9/4½ L Dual Flush	11L High Flush
1996	70.0%	25.0%	5.0%
2001	85.0%	15.0%	0.0%
2006	95.0%	5.0%	0.0%
2011	95.0%	5.0%	0.0%

Table 10.3: Summary of New Appliance Market Share – 6/3 L Dual Flush Fixture Model

Year	6/3 L Dual Flush	9/4½ L Dual Flush	11L High Flush
1996	70.0%	25.0%	5.0%
2001	85.0%	15.0%	0.0%
2006	95.0%	5.0%	0.0%
2011	95.0%	5.0%	0.0%

The assumptions detailed in Tables 10.1, 10.2 & 10.3 were also applied to the Residential Flats, Commercial and Public sectors.

The assumptions detailed in Tables 10.4, 10.5 & 10.6 were applied to reduce the Commercial sector's toilet end water use.

Table 10.4: Summary of Existing Appliance Market Share – Urinal (Commercial) Fixture Model

Type of Appliance / Fixture	Volume per Use (Litres)	Initial Proportions
Waterless	0.01	0.0%
4½ Litres	4.5	5.0%
High Flush	12	95.0%

Table 10.5: Summary of Replacement Appliance Market Shares – Urinal (Commercial) Fixture Model

Year	Waterless	4.5 Litres	High Flush
1996	0.1%	2.5%	97.4%
2001	0.1%	20.0%	79.9%
2006	0.5%	40.0%	59.5%
2011	1.0%	60.0%	39.0%

Table 10.6: Summary of New Appliance Market Share – Urinal (Commercial) Fixture Model

Year	Waterless	4½ Litres	High Flush
1996	0.1%	2.5%	97.4%
2001	0.1%	20.0%	79.9%
2006	0.5%	40.0%	59.5%
2011	1.0%	60.0%	39.0%

10.2 Water Efficiency Plans

Water Efficiency Plans have been formulated, based on the results of the analyses previously discussed in Section 8. These plans have been created to give an indication of the kind of program that a utility could undertake, to achieve some level of water saving.

Each section below contains a brief discussion about the pilot community's water use, then lists each of the measures that are deemed cost-beneficial and could produce a substantial water saving to justify the implementation of the measure. A summary of the potential costs and savings associated with the implementation of the two programs in each community list out:

- *Program Cost: First Five Years Total Cost.* The total cost incurred during the first five years of a program's implementation.

- *Program Cost: Annual Average Cost.* The average cost of implementing a program over a thirty year period.

  For most of the programs that have been formulated, the "First Five Years Total Cost" will be significantly higher than that of the "Annual Average Cost", as most of the programs require an initial, large capital expenditure to instigate the program. The costs associated with the program will then diminish over time, explaining the lower average annual cost.

- *Energy Savings: First 5 Years Saving.* The sum of the potential energy savings that could be realised during the first five years of a program's implementation.

- *Energy Savings: Annual Average Saving.* The average savings that could be realised upon implementing a program over a thirty year period.

- *Benefit / Cost Ratio: Water Authority.* The benefit / cost to the water authority instigating the water conservation program.

- *Benefit / Cost Ratio: Total Community.* The benefit / cost to the community upon which the water conservation program is being implemented.

10.2.1 Emerald

Emerald has a relatively high account usage in the residential sector (approximately 1150 L/account/day). This demand could be targeted through an aggressive program. Growth in the town is expected to be relatively high and therefore the use of plumbing fixture regulations will achieve water use reduction in new dwellings.

The high B/C measures from the analysis of the Emerald alternative measures are listed in **Table 10.7**. Measures are ranked according to total community B/C ratio.

Table 10.7: Emerald - High B/C Measures

Measure Name	Water Utility B/C	Community B/C	Average Water Savings (ML/d)
Residential Flats Shower - $10 Rebate	5.63	10.42	0.01
Residential Houses Shower - $10 Rebate	5.07	9.68	0.06
Residential Flats Shower - $20 Rebate	4.63	8.59	0.02
Residential Houses Shower - $20 Rebate	2.09	7.99	0.10
Residential Flats Shower - $30 Rebate	2.90	5.38	0.02
Residential Houses Shower - $30 Rebate	0.75	5.00	0.11
Public Education	2.38	4.47	0.02
School's WaterWise Campaign	2.14	4.46	0.01
Irrigation Advisory Service	4.38	4.38	0.04
Residential Water Audit & Tune Up ($50 Cost to Customer)	1.33	4.04	0.03
Residential Water Audit & Tune Up ($ 0 Cost to Customer)	0.73	4.04	0.15
Residential Water Audit & Tune Up ($30 Cost to Customer)	1.00	4.04	0.06
Toilet Flush Arrestor	3.21	3.21	0.04
Toilet Displacement Device	2.16	2.16	0.02
Residential Water Audit	1.26	1.95	0.07
Outdoor Audit and $50 Rebate	1.62	1.62	0.14
Outdoor Audit and $30 Rebate	1.51	1.31	0.07
Utility Based Measure Only			
Leakage Reduction	2.04	2.04	0.39

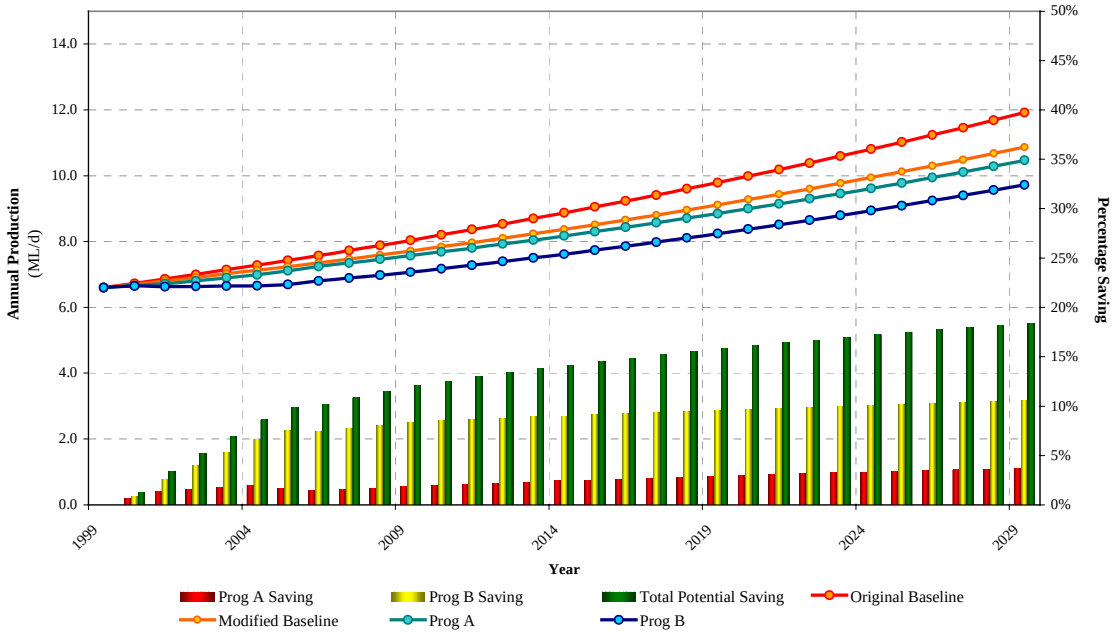
Two plans were developed for Emerald based on the criteria outlined in Section 10.1. **Table 10.8** provides a listing of the measures adopted for the passive and active plans.

Table 10.8: Emerald – Water Efficiency Plans

Measure Description	Program A	Program B
School WaterWise – Literature	✓	✓
Public Education	✓	✓
Outdoor Audit and $30 Rebate	✓	✓
Residential Houses Shower Head Replacement ($20 Rebate)	×	✓
Residential Flats Shower Head Replacement ($20 Rebate)	×	✓
Toilet Flush Arrestor	✓	✓
Leakage Reduction	×	✓

The expected impacts on water demand of implementing the water efficiency plans and the water savings anticipated for each program are shown in **Figure 10.1**. Reductions in demand over the current projections, which may be expected from natural conservation, are also presented in the figure.

Figure 10.1: Emerald – Demand Projections and Savings



As can be seen in **Table 10.1**, a total saving of approximately 18% would be achieved through the implementation of an Active program. Of this saving 8% would be expected to be achieved by natural conservation and 10% through the water efficiency plan.

The B/C ratios realised through the implementation of the two water efficiency plans are summarised in **Table 10.9**. Program costs, water and energy savings are also presented.

Table 10.9: Emerald – Summary of Plan Costs and Savings

Summary		Program	
		A	*B* (includes leakage reduction)
Program Cost	*First 5 Years Total Cost*	$60,883	$234,241
	Annual Average Cost	$5,928	$27,614
Energy Savings	*First 5 Years Saving*	$26,002	$31,157
	Annual Average Saving	$5,276	$6,350
Benefit/Cost Ratio	*Water Authority*	3.55	2.53
	Total Community	11.59	4.17
Average Water Savings (ML/d)		0.21	0.71

The results presented above suggest that the implementation of either an active or passive program would substantially benefit the community and authority. The

resultant water saving will result in delays of about two to three years to major capital works.

As indicated in the summary of costs and savings, the cost per ML of water saved increases from Program A to Program B. This is due to the inclusion of more expensive measures in the program, ie. leakage reduction. Benefit/Cost ratios for these measures are lower than for the passive program and therefore the B/C ratio for the active program is reduced. On the other hand, water savings are increased for the active program.

Additional water savings could be achieved through the following initiatives:

- The implementation of a carefully planned program of water audits and water efficiency improvements in the following commercial properties:
  - public buildings
  - hotels/motels
  - schools
  - hospitals
- Regulations involving plumbing fixtures for new housing would increase the level of water efficiency for toilets, showers and taps.
- The investigation and possible implementation of a two tiered pricing structure for residential customers.
- The use of co-sponsoring should be considered for energy related initiatives such as showerhead replacement, the internal audit and retrofit program and possibly washing machine rebate measure.
- Regulations relating to urinal flush controllers or alternatively waterless urinals may be considered for hotels, clubs and public buildings.

10.2.2 Ingham

Ingham is a small community, with low growth projected for the future. Due to low growth, it is anticipated that a capital works program will not be required for capacity augmentation. This presents a unique situation within this study, as Ingham is the only location without capital works, and therefore savings relating to delayed capital costs are not possible. In addition costs relating to the production and transfer of water and sewage are low compared to other communities.

Table 10.10 lists the measures that give a positive benefit/cost to the community. As shown in the table, the utility benefits are low to marginal, and present little advantage in terms of the water saved. However, the outdoor audit and rebate scheme has been included, as it has the potential to realise relatively higher water savings than the other measures listed.

Table 10.10: Ingham - High B/C Measures

Measure Name	Water Utility B/C	Community B/C	Average Water Savings (ML/d)
Residential Houses Shower - $10 Rebate	1.33	6.03	0.04
Residential Houses Shower - $20 Rebate	0.55	4.98	0.07
Residential Houses Shower - $30 Rebate	0.20	3.12	0.08
Residential Flats Shower - $10 Rebate	0.52	2.29	0.01
Residential Water Audit & Retrofit ($50 Cost to Customer)	0.41	1.97	0.03
Residential Water Audit & Retrofit ($30 Cost to Customer)	0.30	1.97	0.06
Residential Water Audit & Retrofit ($0 Cost to Customer)	0.22	1.97	0.15
Residential Flats Shower - $20 Rebate	0.43	1.89	0.01
School's WaterWise Campaign	0.27	1.85	0.00
Public Education	0.26	1.54	0.01
Residential Flats Shower - $30 Rebate	0.27	1.18	0.01
Outdoor Audit & Rebate - $30 Rebate	0.10	0.08	0.03

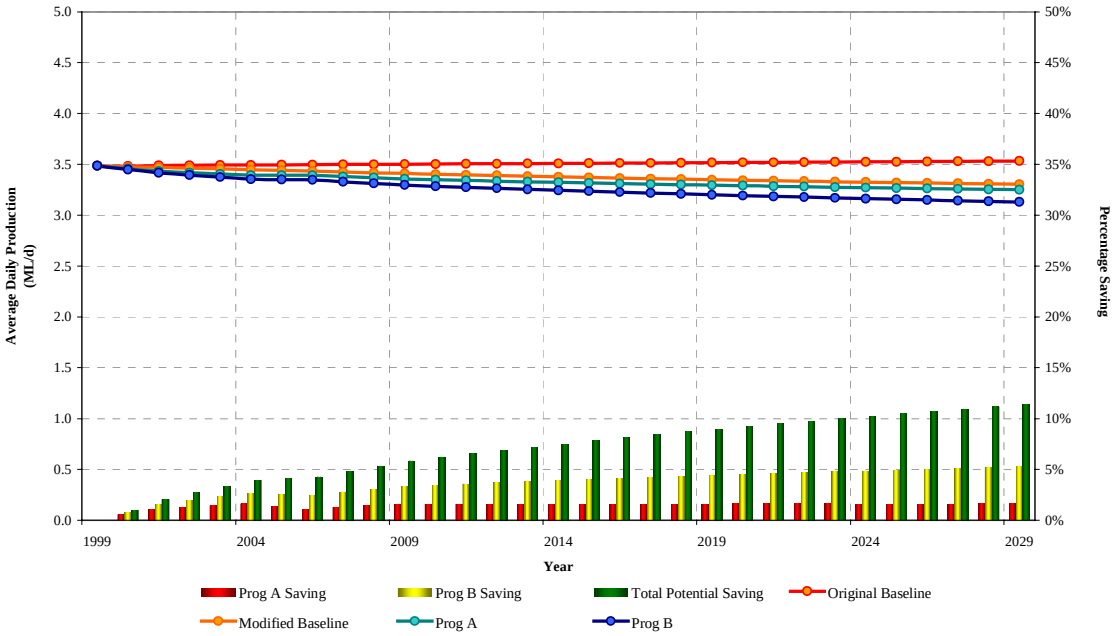
Two plans were developed for Ingham based on the criteria outlined in Section 10.1. **Table 10.11** provides a listing of the elements adopted for the passive and active plans. Residential shower replacement rebates of $20 have been included in Program B as it is assumed that the active program would gain co-sponsoring with the local electricity company.

Table 10.11: Ingham – Water Efficiency Plans

Measure Description	Program A	Program B
School WaterWise – Literature	✓	✓
Public Education	✓	✓
Outdoor Audits and Tap Timer Information Kit ($30 Cost to Customer)	✓	✓
Residential Houses Shower Head Replacement ($20 Rebate)	×	✓
Residential Flats Shower Head Replacement ($20 Rebate)	×	✓

Expected impacts on demand of implementing the water efficiency plans and the water savings anticipated from the initiatives are shown in **Figure 10.2**. The savings over the current projections, which may be expected from natural conservation, are also presented in the figure.

Figure 10.2: Ingham – Demand Projections and Savings



As can be seen in **Figure 10.2** the total potential savings are 12% with approximately 5% of the savings being attributed to the active water efficiency plan. The B/C ratios realised through the implementation of the two water efficiency plans are summarised in **Table 10.12**. Program costs, water and energy savings are also presented.

Table 10.12: Ingham - Summary of Plan Costs and Savings

Summary		Program	
		A	*B*
Program Costs	*First 5 Years Total Cost*	$69,678	$101,254
	Annual Average Cost	$6,103	$12,249
Energy Savings	*First 5 Years Savings*	$236	$22,019
	Annual Average Savings	$9	$3,166
Benefit/Cost Ratio	*Water Authority*	0.15	0.31
	Total Community	0.16	2.40
Average Water Savings (ML/d)		0.05	0.12

The savings that could be realised from the proposed plans relate only to the cost savings from reduced cost of production and pumping, and wastewater related cost reductions. From the communities' perspective it is the reduction in other costs such as energy, which are important. As a result, there is little scope in Ingham for a more detailed water efficiency program. It is suggested that education programs are pursued, as there is potential for customers to gain from energy cost reduction. The programs for Ingham present the community with reasonable benefits, but the utility would receive extremely low benefits from implementing the program. The community should be encouraged to save water through the passive plan activities such as advertising and leaflets. The utility will realise a higher benefit/cost ratio if measures such as the showerhead replacement measure were to be co-sponsored or the full subsidy provided by the State government or energy companies.

Hinchinbrook Shire also have the option of amending the water pricing structure to provide a greater level of reward to the residential users. This could be achieved through two actions:

- The reduction of the fixed component of the pricing structure. Currently this component accounts for around 60% of the average water bill.
- Increasing the frequency of meter reading to at least a quarterly cycle. This provides better feedback to the customers on their performance and enables public education to occur.

10.2.3 Mackay

The Mackay analysis was complicated due to the lack of data. This resulted from difficulties due with reporting from the Council's billing system. As a result, billing data was not available to categorise customers and a number of additional assumptions were needed to estimate the customer category breakdown.

The measures that proved cost effective for Mackay are listed in **Table 10.13**. The outdoor audit and rebate scheme was also included because of the relatively high potential water savings that could be realised.

Table 10.13: Mackay – High B/C Measures

Measure Description	Water Utility B/C	Total Community B/C	Average Water Savings (ML/d)
Residential Houses Shower - $10 Rebate	5.30	10.14	0.41
Residential Houses Shower - $20 Rebate	2.19	8.37	0.67
Irrigation Advisory Service	8.03	8.03	0.13
Residential Flats Shower - $10 Rebate	3.32	6.18	0.10
Residential Houses Shower - $30 Rebate	0.79	5.24	0.77
Residential Flats Shower - $20 Rebate	2.74	5.10	0.17
Residential Water Audit & Tune Up ($0 Cost to Customer)	0.90	3.65	1.60
Residential Water Audit & Tune Up ($30 Cost to Customer)	1.21	3.62	0.64
Residential Water Audit & Tune Up ($50 Cost to Customer)	1.60	3.62	0.32
Public Education	1.38	3.61	0.11
School's WaterWise Campaign	1.13	3.56	0.04
Residential Flats Shower - $30 Rebate	1.71	3.19	0.19
Toilet Flush Arrestor	2.69	2.69	0.25
Toilet Displacement Device	1.81	1.81	0.17
Washing Machine Labelling	2.40	0.86	0.03
Outdoor Audit and Tap Timer Info Kit ($30 Cost to Customer)	0.69	0.69	0.44
Utility Based Measure Only			
Leakage Reduction	2.03	2.03	0.81

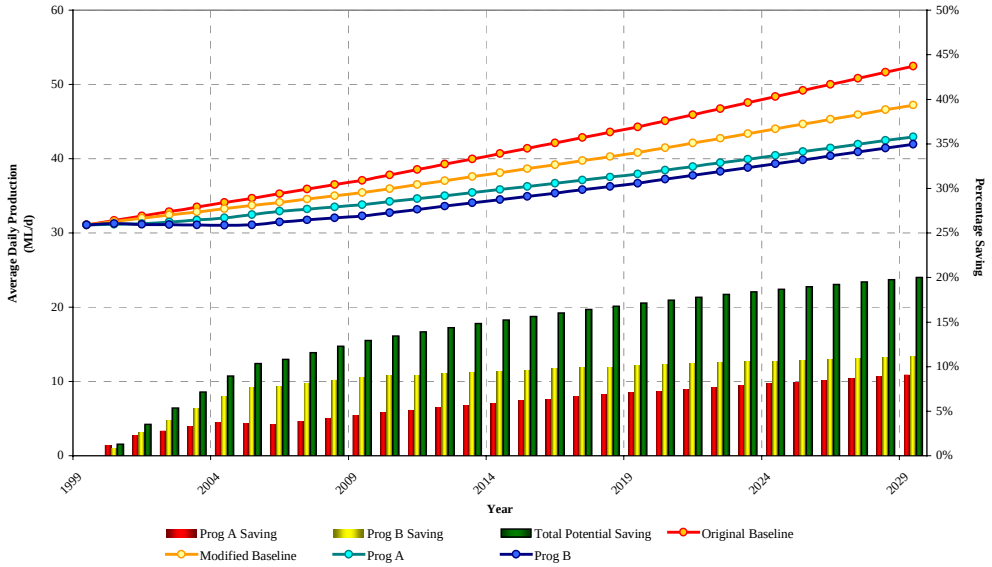
Two plans were developed for Mackay based on the criteria outlined in Section 10.1. **Table 10.14** provides a listing of the elements adopted for the passive and active plans.

Table 10.14: Mackay – Water Efficiency Plans

Measure Description	Program A	Program B
School WaterWise – Literature	✓	✓
Public Education	✓	✓
Outdoor Audits and Tap Timer Information Kit ($30 Cost to Customer)	✓	✓
Washing Machine Labelling	✓	✓
Residential Houses Shower Head Replacement ($20 Rebate)	✓	✓
Residential Flats Shower Head Replacement ($20 Rebate)	✓	✓
Residential Audit & Retrofit ($30 Customer Cost)	✗	✓
Leakage Reduction	✗	✓

Expected impacts on demand of implementing the water efficiency plans and the water savings anticipated from the initiatives are shown in **Figure 10.3**. The savings over the current projections which may be expected from natural conservation are also presented in the figure.

Figure 10.3: Mackay – Demand Projections and Savings



As can be seen in **Figure 10.3** the total potential saving is approximately 20% over the 30 years of the analysis. Approximately 12% of this saving relates to natural conservation, whilst 8% reduction may be achieved through the implementation of Program B.

The B/C ratios realised through the implementation of the two water efficiency plans are summarised in **Table 10.15**. Program costs, water and energy savings are also presented.

Table 10.15: Mackay - Summary of Plan Costs and Savings

Summary		Program	
		A	*B* (includes leakage reduction)
Program Costs	*First 5 Years Total Cost*	$422,700	$1,082,735
	Annual Average Cost	$76,733	$183,721
Energy Savings	*First 5 Years Saving*	$182,464	$331,244
	Annual Average Saving	$35,585	$54,165
Benefit/Cost Ratio	*Water Authority*	3.23	1.63
	Total Community	4.94	4.03
Average Water Savings (ML/d)		2.29	3.38

The results of this analysis indicate that either of the programs would substantially benefit the community and authority. The resultant water savings achieve delays to capital works of two to five years. Capital works that are planned for the later period of the analysis timeframe will be delayed by up to six years.

As indicated in the summary of costs and savings, the cost per ML of water saved increases from Program A to Program B. This is due to the inclusion of more expensive measures in the program, ie. leakage reduction and residential retrofit. Benefit/Cost ratios for these measures are lower than for the passive program and therefore the B/C ratio for the active program is reduced. On the other hand, water savings are increased for the active program.

In addition to the above programs the following initiatives should be considered for Mackay:

- The implementation of a comprehensive user pays system with zero allowance. The pricing structure should consider multiple tiers for residential water use and a single block for non-residential users. It is estimated that such an initiative combined with the water meter upgrading program could achieve an additional 10% reduction to average residential demand.
- The implementation of a carefully planned program of water audits and water efficiency improvements in the following non-residential customer groups:
  - public buildings (including landscaping)
  - hotels/motels and resort accommodation
  - schools
  - major industry (high water users)
  - hospitals
- Introduction of regulations relating to plumbing fixtures in residential dwelling construction to augment the natural conservation process.
- Introduction of regulations relating to the control of urinal flush volumes for commercial properties such as hotels, clubs and public buildings. Waterless urinals may also be considered as alternatives.

- Opportunities for co-sponsoring need to be pursued e.g. showerhead replacement, residential audit and retrofit and washing machine rebate programs.

10.2.4 Maroochy

Significant growth is expected in the Maroochy area over the next 30 years. The existing population is approximately 110,400 (1999), and a population of 300,000 is projected for 2029. This high level of growth will lead to a substantial natural conservation, as new properties are developed with smaller lot sizes and water efficient fixtures such as 6/3 L flush toilets.

The measures that proved cost effective (with a reasonable level of potential water saving) for the Maroochy area are listed in **Table 10.16**.

Table 10.16: Maroochy - High B/C Measures

Measure Description	Water Utility B/C	Total Community B/C	Average Water Savings (ML/d)
Irrigation Advisory Service	29.34	29.34	0.23
Residential Houses Shower - $10 Rebate	4.49	9.38	0.65
Residential Houses Shower - $20 Rebate	1.86	7.75	1.06
Residential Houses Shower - $30 Rebate	0.67	4.85	1.22
School's WaterWise Campaign	1.44	3.74	0.07
Residential Flats Shower - $10 Rebate	1.77	3.58	0.31
Public Education	0.96	3.53	0.19
Residential Flats Shower - $20 Rebate	1.46	2.95	0.51
Residential Water Audit & Tune Up ($0 Cost to Customer)	0.42	2.00	0.60
Residential Water Audit & Tune Up ($30 Cost to Customer)	0.57	2.00	1.21
Residential Water Audit & Tune Up ($50 Cost to Customer)	0.77	2.00	3.02
Residential Flats Shower - $30 Rebate	0.91	1.85	0.58
Outdoor Audit & Tap Timer Kit ($0 Cost to Customer)	1.79	1.79	0.91
Outdoor Audit & Tap Timer Kit ($20 Cost to Customer)	2.13	1.72	0.46
Outdoor Audit & Tap Timer Kit ($30 Cost to Customer)	2.27	1.64	0.23
Residential Water Audit	0.61	1.18	0.60
Toilet Flush Arrestor	1.10	1.10	0.45
Utility Based Measure Only			
Leakage Reduction	2.03	2.03	1.81

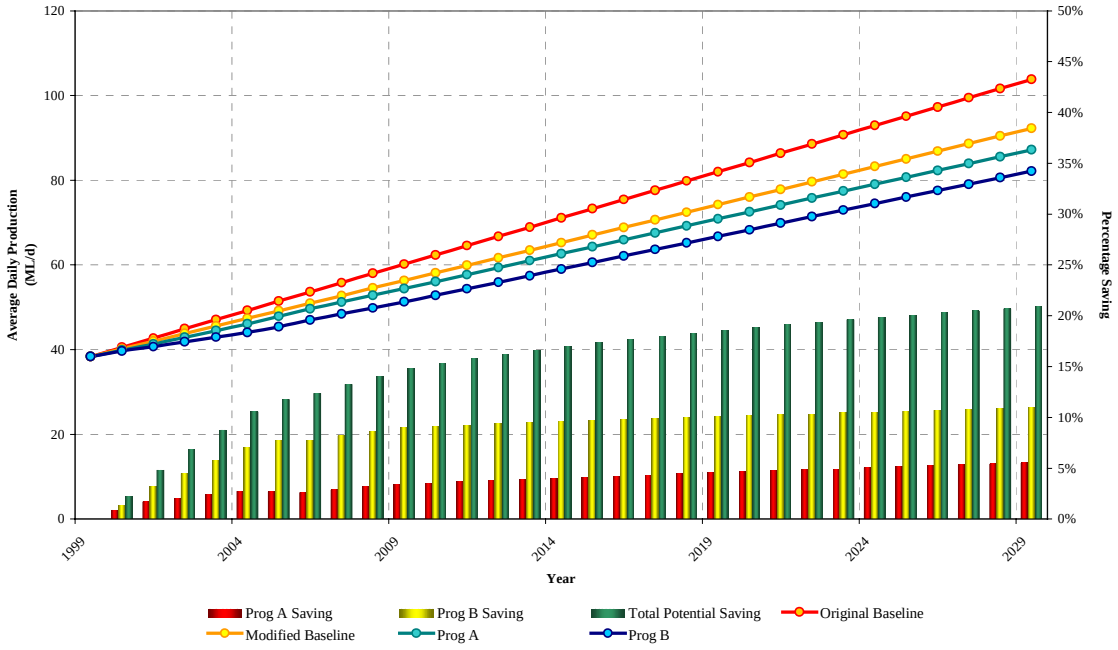
To formulate the water efficiency plans, it was necessary to remove measures that were variations to the same concept, and retain the most beneficial measure to both the authority and the community. Selection of measures was based on the criteria outlined in Section 10.1. **Table 10.17** provides a listing of the elements adopted for the passive and active plans.

Table 10.17: Maroochy – Water Efficiency Plans

Measure Description	Program A	Program B
School WaterWise – Literature	✓	✓
Public Education	✓	✓
Outdoor Audits and Tap Timer Information Kit ($30 Cost to Customer)	✓	✓
Residential Houses Shower Head Replacement ($20 Rebate)	✓	✓
Residential Flats Shower Head Replacement ($20 Rebate)	✓	✓
Toilet Flush Arrestor	✓	✓
Residential Audit & Retrofit ($30 Customer Cost)	✗	✓
Leakage Reduction	✗	✓

Expected impact on water demand projections resulting from the implementation of the water efficiency plans together with the anticipated water savings are shown in **Figure 10.4**. The savings over the current projections which may be expected from natural conservation are also presented in the figure.

Figure 10.4: Maroochy – Demand Projections and Savings



As can be seen in **Figure 10.4** a maximum reduction of 21% in demand could be expected by 2029. Of the total savings, 10% will be due to natural conservation and 11% from the active efficiency program.

The B/C ratios realised through the implementation of the two water efficiency plans are summarised in **Table 10.18**. Program costs, water and energy savings are also presented.

Table 10.18: Maroochy - Summary of Plan Costs and Savings

Summary		Program	
		A	*B* *(includes leakage reduction)*
Program Costs	*First 5 Years Total Cost*	$879,976	$2,306,491
	Annual Average Cost	$248,601	$588,234
Energy Savings	*First 5 Years Cost*	$411,493	$612,729
	Annual Average Cost	$112,525	$140,660
Benefit/Cost Ratio	*Water Utility*	1.54	1.24
	Total Community	3.70	2.79
Average Water Savings (ML/d)		2.65	5.95

The results obtained for Maroochy suggest that there would be substantial savings for both the utility and community for both programs.

As indicated in the summary of costs and savings, the cost per ML of water saved increases from Program A to Program B. This is due to the inclusion of more expensive measures in the program, ie. leakage reduction and residential retrofit. Benefit/Cost ratios for these measures are lower than for the passive program and therefore the B/C ratio for the active program is reduced. On the other hand, water savings are increased for the active program.

Further initiatives that would be considered for the water efficiency plan in Maroochy Shire are:

- The implementation of a carefully planned program of water audits and water efficiency improvements in the following commercial sector groups:
  - hotels/motels/clubs
  - resorts and tourist accommodation
  - tourist facilities
  - public buildings
  - schools
  - hospitals
  - major industrial premises (high water users)
  - shopping centres
- The introduction of an education program for tourist accommodation, aimed at changing practices of tourists.
- The investigation of a two tiered water pricing policy for residential customers.
- The use of co-sponsoring for energy related initiatives such as showerhead replacement, internal audits and retrofits and possibly for washing machine rebate measures.

- The introduction of regulations involving the installation of water efficient plumbing fixtures in new residential developments.
- The introduction of regulations relating to urinal flush controllers or alternatively waterless urinals for hotels, clubs and public buildings.

10.2.5 Toowoomba

The most cost effective measures determined in the analysis for Toowoomba are summarised in **Table 10.19**.

Table 10.19: Toowoomba – High B/C Measures

Measure Description	Water Utility B/C	Total Community B/C	Average Water Savings (ML/d)
Irrigation Advisory Service	29.76	29.76	0.09
Residential Houses Shower - $10 Rebate	6.66	10.66	0.40
Residential Houses Shower - $20 Rebate	2.89	8.87	0.67
Residential Houses Shower - $30 Rebate	1.05	5.57	0.77
School's WaterWise Campaign	2.16	4.61	0.03
Residential Flats Shower - $10 Rebate	2.43	3.99	0.07
Residential Water Audit & Retrofit ($50 Cost to Customer)	2.21	3.73	0.30
Landscape Use Efficiency	3.68	3.68	0.23
Residential Water Audit & Retrofit ($30 Cost to Customer)	1.55	3.65	0.60
Residential Water Audit & Retrofit ($0 Cost to Customer)	0.96	3.49	1.49
Toilet Flush Arrestor	3.39	3.39	0.24
Residential Flats Shower - $20 Rebate	2.02	3.30	0.11
Public Education	1.03	3.09	0.09
Toilet Displacement Device	2.34	2.34	0.16
Residential Flats Shower - $30 Rebate	1.27	2.07	0.12
Outdoor Audit & Rebate - $50 Rebate	1.76	1.76	0.26
Residential Water Audit	1.01	1.63	0.20
Outdoor Audit & Rebate - $30 Rebate	1.78	1.45	0.14
Outdoor Audit & Rebate - $20 Rebate	1.70	1.25	0.07
Utility Based Measure Only			
Leakage Reduction	2.03	2.03	0.81

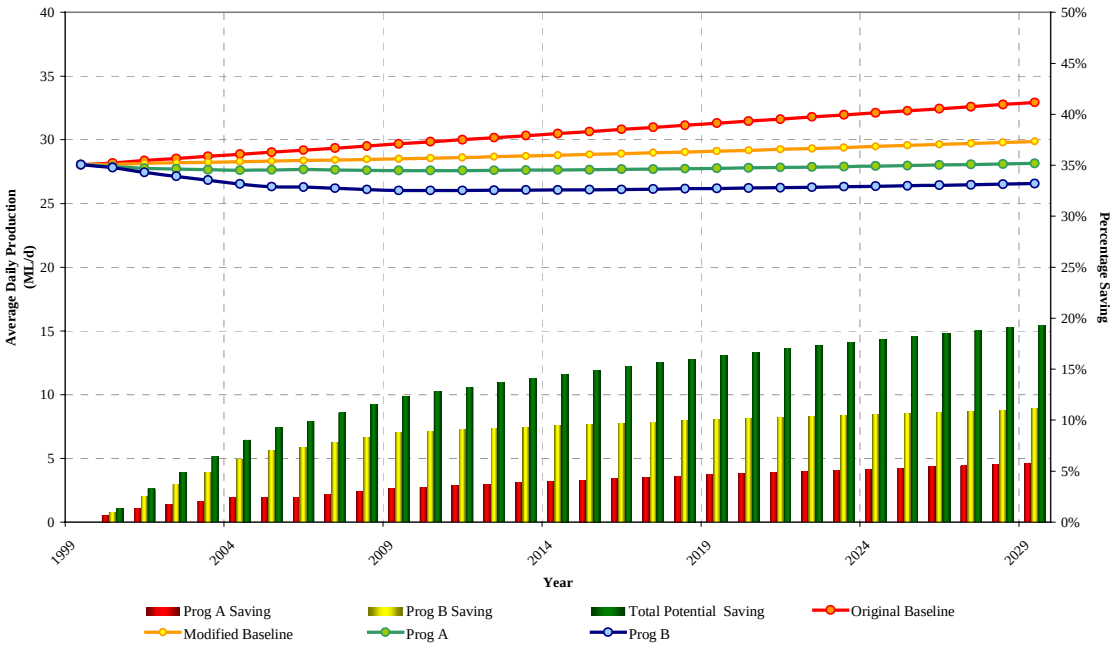
Some of the measures in **Table 10.19** are variations of the same concept. To formulate the water efficiency plans, the most beneficial measure to both the utility and the community was selected. Development of the plan was based on the criteria outlined in Section 10.1. **Table 10.20** provides a listing of the elements adopted for the passive and active plans (programs A and B respectively).

Table 10.20: Toowoomba – Water Efficiency Plans

Measure Description	Program A	Program B
School WaterWise – Literature	✓	✓
Public Education	✓	✓
Outdoor Audits and Tap Timer Information Kit ($30 Cost to Customer)	✓	✓
Residential Houses Shower ($20 Rebate)	✓	✓
Residential Flats Shower ($20 Rebate)	✓	✓
Residential Audit & Retrofit ($30 Customer Cost)	✗	✓
Leakage Reduction	✗	✓

Expected impacts on water demand projections resulting from the implementation of the water efficiency plans together with the water anticipated savings are shown in **Figure 10.5**. The savings over the current projections, which may be expected from natural conservation, are also presented in the figure.

Figure 10.5: Toowoomba – Demand Projections and Savings



As can be seen in **Figure 10.5** the implementation of an active Water Efficiency Plan would reduce demand to below the current production levels. An initial lowering of demand would be experienced due to the leakage reduction program, with a sustained reduction until 2030 achieved through such measures as the showerhead replacement and residential retrofit. The expected saving including natural conservation would be

19% with a 11% reduction in demand being attributed to the active Water Efficiency Program.

The benefit/cost ratios determined in the analysis for Toowoomba are generally in the high range of expectations. The reasons for these high B/C ratios were attributed to:

- The high bulk water transfer costs in the Toowoomba region. The cost of transferring one megalitre of water from the dams to the Mount Kynoch Treatment Plant equated to approximately $63.
- The population growth rate in the Toowoomba area is relatively low, and consequently, when natural water conservation is factored into demand forecasts, the water savings outweigh the demand growth from increased population.

The results of the economic analysis for the two programs are summarised in **Table 10.21**. Program costs, water and energy savings are also presented.

Table 10.21: Toowoomba - Summary of Plan Costs and Savings

Summary		**Program**	
		A	*B* *(includes leakage reduction)*
Program Costs	*First 5 Years Total Cost*	$548,975	$1,431,030
	Annual Average Cost	$93,722	$224,828
Energy Savings	*First 5 Years Saving*	$285,469	$420,231
	Annual Average Saving	$44,886	$54,320
Benefit/Cost Ratio	*Water Utility*	2.44	1.54
	Total Community	5.70	3.76
Annual Water Savings (ML/d)		1.08	2.42

As indicated in the summary of costs and savings, the cost per ML of water saved increases from Program A to Program B. This is due to the inclusion of more expensive measures in the program, ie. leakage reduction and residential retrofit. Benefit/Cost ratios for these measures are lower than for the passive program and therefore the B/C ratio for the active program is reduced. On the other hand, water savings are increased for the active program.

Further initiatives that may be considered for the Water Efficiency Plan in Toowoomba are as follows:

- Amendments to the pricing policy should be investigated to:
  - lower the fixed charge which is currently a high proportion (approximately 60%) of the average users' total bill. This will provide the maximum reward for customers choosing to conserve water.
  - Increasing the frequency of meter reading to at least a quarterly cycle to provide better feedback to the customers on water usage, and encourage conservation.
- The implementation of a carefully planned program of water audits and water efficiency improvements in the following commercial sector groups:

- public buildings
- hotels/motels
- schools
- shopping centres
- hospitals

- The introduction of regulations involving plumbing fixtures for new housing would increase the efficiency of showers, toilets and taps. Although there is not high growth in Toowoomba, this measure will assist natural conservation through the increased availability of fittings in local retail outlets.
- The introduction of regulations for urinal flush controllers or waterless urinals in hotels, motels, clubs, restaurants and public buildings.

10.3 Summary of Findings

A summary of the conclusions drawn for the formulation of water efficiency or demand management plans for the five pilot communities is as follows:

- The effects of *natural conservation* over the next 30 years will realise reductions in overall demand of between 6.5 and 11.1 % over the currently projected demands. For this analysis, natural conservation is assumed to result from the increased market share of low flow showerheads, 6/3L toilets, tap flow control, washing machines and urinal flush control.

  A summary of the natural conservation impacts determined for each pilot community to 2030 is detailed in **Table 10.22**.

Table 10.22: Impact of Natural Conservation on Demand Estimates to 2030

Community	% Natural Conservation	Water Saving (ML/d)
Emerald	8.8%	1.1
Ingham	6.5%	0.2
Mackay	10.0%	5.2
Maroochy	11.1%	11.5
Toowoomba	9.3%	3.1

- *Passive water efficiency plans* have the potential to save between 1.6 and 9.1% of water usage. Programs would include measures such as public education and showerhead rebate programs. *Active water efficiency plans* have the potential to save between 5 and 12 % of the overall demand at 2030. Such programs require community support and cooperation to ensure high participation rates. The selected measures for the passive and active plans are summarised in the table below.

Table 10.23: Summary of Passive and Active Program Savings to 2030

Community	Passive Plan		Active Plan	
	% Saving	ML/d	% Saving	ML/d
Emerald	3.7%	0.4	10.5%	1.1
Ingham	1.6%	0.1	5.3%	0.2
Mackay	9.1%	4.3	11.2%	5.3
Maroochy	5.5%	5.1	11.0%	10.1
Toowoomba	5.8%	1.7	11.1%	3.3

- The selected measures for the passive and active plans are summarised in **Table 10.24**.

Table 10.24: Passive and Active Program Components

Community	Emerald		Ingham		Mackay		Maroochy		Toowoomba	
Measure	**P**	**A**	**P**	**A**	**P**	**A**	**P**	**A**	**P**	**A**
School WaterWise – Literature	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Public Education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Showerhead Replacement ($20 Rebate)										
• **Houses**	×	✓	×	✓	✓	✓	✓	✓	✓	✓
• **Flats**	×	✓	×	✓	✓	✓	✓	✓	✓	✓
Residential Audit & Retrofit ($30 Cost to Customer)	×	×	×	×	×	✓	×	✓	×	✓
Washing Machine Labelling	×	×	×	×	×	×	✓	✓	×	×
Outdoor Audit & Tap Timer Kit ($30 Cost to Customer)	✓	✓	✓	✓	×	×	✓	✓	✓	✓
Toilet Flush Arrestor	×	×	×	×	×	×	✓	✓	×	×
Leakage Reduction	×	✓	×	×	×	✓	×	✓	×	✓
P – Passive; A – Active										

- Overall the levels of demand currently being planned for in all communities may be reduced by at least 10 % and up to 25 % taking into account natural conservation and savings resulting from the implementation of an active water efficiency plan. A summary of the potential reduction to currently planned capacity at 2030, for the communities analysed is detailed in **Table 10.25**.

Table 10.25: Reduction in Planned Capacity at 2030

Community	Planned Demand (ML/d)	Demand With Active Program (ML/d)	% Reduction
Emerald	11.9	9.7	18.5%
Ingham	3.5	3.1	11.4%
Mackay	52.4	41.9	20.0%
Maroochy	103.8	82.1	20.9%
Toowoomba	32.9	26.6	19.1%

- Demand reduction of a further 3 to 10% may be achieved through additional actions summarised as follows:
  - Implementation of water audits and efficiency improvements in the non-residential sector with the following priority:
    - Public buildings
    - Hotels/motels/clubs, resorts and tourist accommodation
    - Schools
    - Major industry
    - Shopping centres
    - Hospitals
  - Introduction of two tiered pricing structures for the residential sector.
  - Reduction of high fixed charges for water to provide the maximum benefit/reward to those who conserve.
  - Adoption of regulations aimed at the installation of water efficient plumbing fixtures in new development, and the control of urinal flushing.

Based on the development of Water Efficiency Plans for the five communities involved in this study it is recommended that:

- Demand projections for all Queensland local governments take into account the effect of natural conservation.
- As shown in this report, the development and implementation of Water Efficiency Plans is cost effective and needs to be considered during the planning of any water supply system.
- Amendments should be made to the QDNR *Guidelines for Planning and Design of Urban Water Supply Systems* to incorporate the requirement to consider both natural conservation and water efficiency, in water supply planning.